Molecular imaging probes – small molecular "sensors" and nanoparticles

- The Laboratory of Molecular Imaging Probes (PI: Alexei Bogdanov (UMMS)

Main collaborators-

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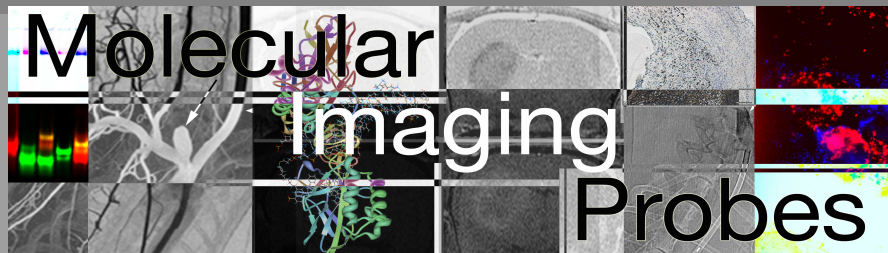
Anand T.M. Kumar (A. Martinos' Center, MGH)

Leonid Margolis (NICHD)

Alexander L. Klibanov (UVA)

Gang Han (UMMS)

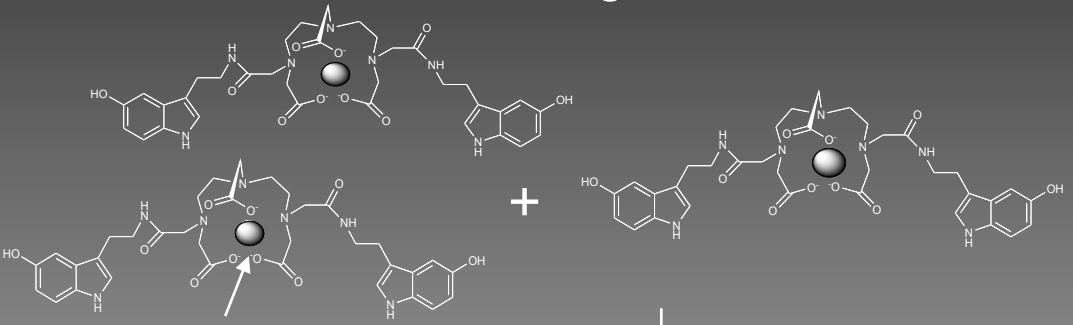
UMASS



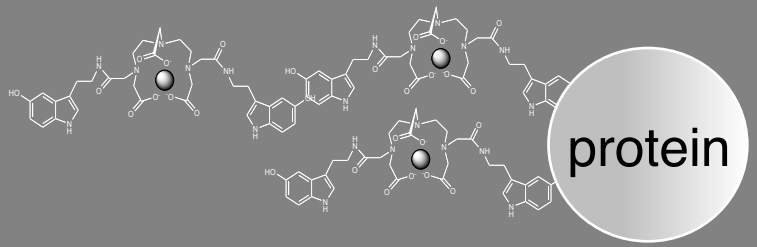
MRI sensors for detecting peroxidase activity

Bogdanov A Jr. et al. Mol Imaging 1:16-23, 2002
Querol M et al. Org Lett. 2005
Querol M et al. Org Biomol Chem. 2006

Small building blocks

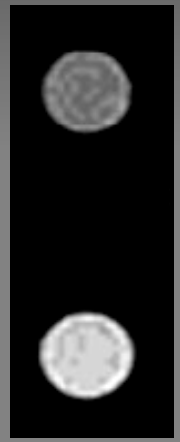


peroxidase



Large products, slow Gd rotation →

Low R1 value



0.45 mM
Gd-substrate

High R1 value

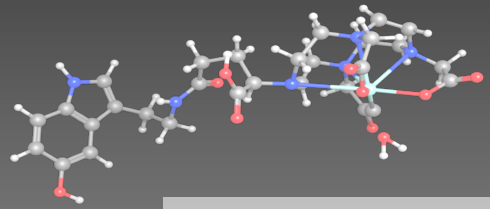
Signal intensity increases:

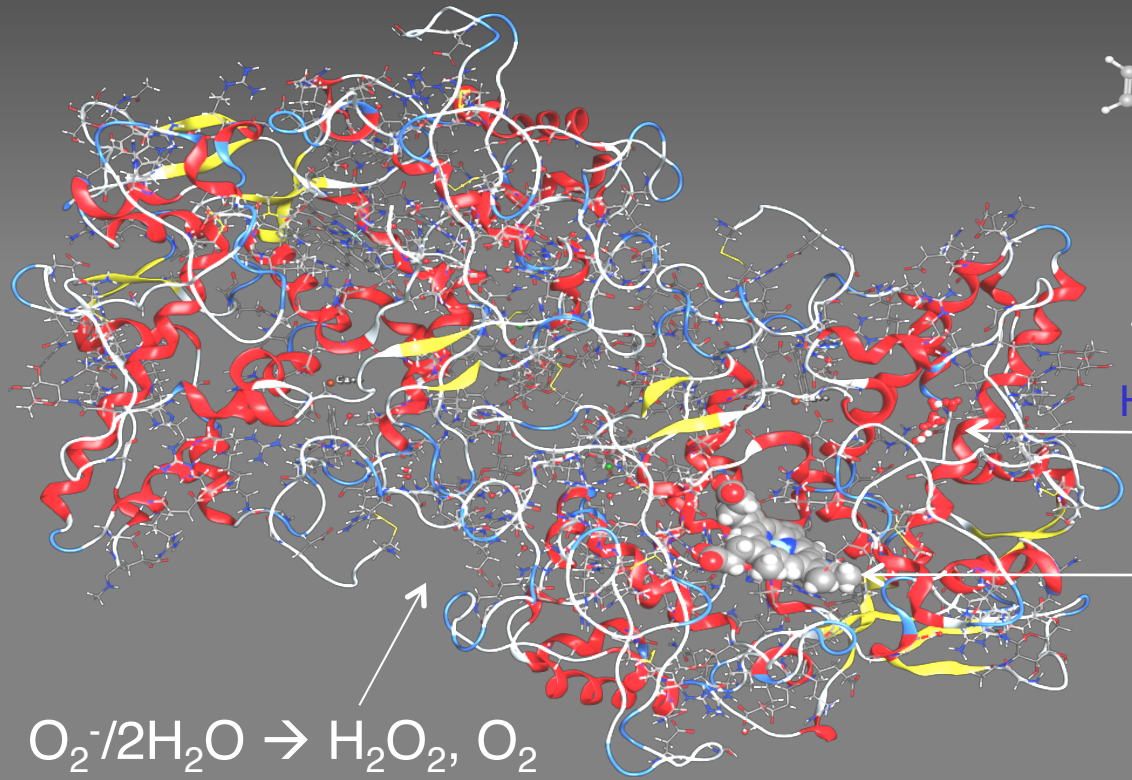
MRamp effect

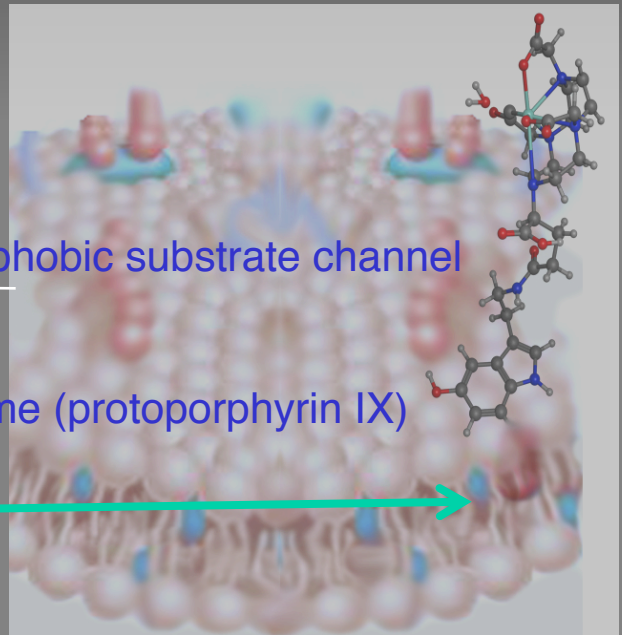
Detecting enzymatic markers of inflammation

Myeloperoxidase

Reducing substrates







Hydrophobic substrate channel

Heme (protoporphyrin IX)

$O_2^-/2H_2O \rightarrow H_2O_2, O_2$

MR Imaging of experimental inflammation in a rabbit model of stable aneurysm.

NEW ENGLAND CENTER FOR STROKE RESEARCH

- diameter of the parent vessel (brachiocephalic trunk) is representative of human intracranial vessels

LPS injected into wall of aneurysm

De Leo III, M et al. Radiology 252:696-703 (2009)

MRI of a rabbit “aneurysm” model

PIs: A. Bogdanov, M. Gounis. **R01 NS091552-01**

Human brain aneurysm rupture risk assessment using non-invasive imaging

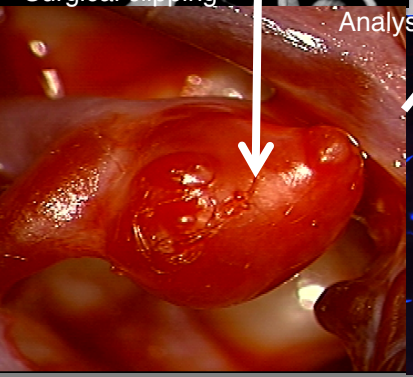
In collaboration with – Drs. J. Weaver (UMMS-Neurosurgery), P. Caravan (MGH), Y. Wadghiri (NYU)

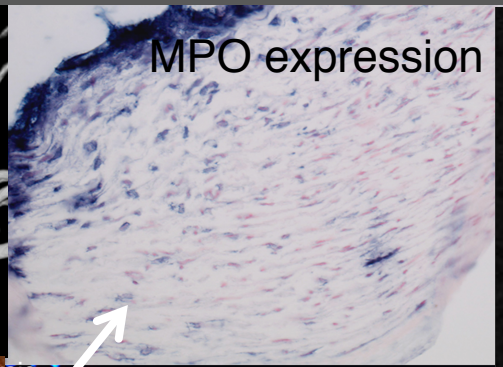
Goal: develop molecular imaging markers for patient stratification

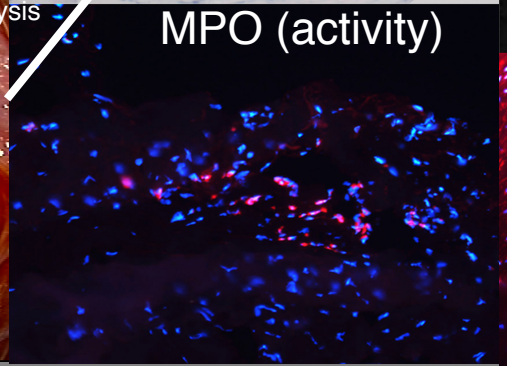
microMRI of human aneurysm

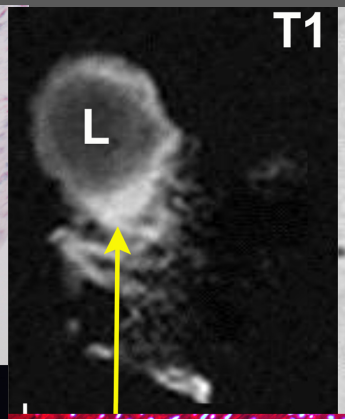
Surgical clipping

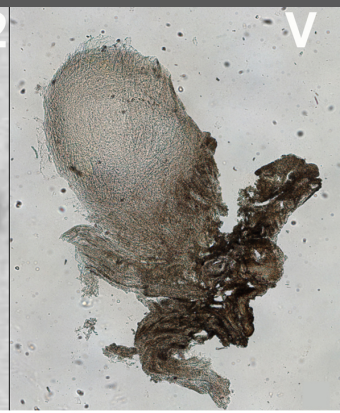
Analysis

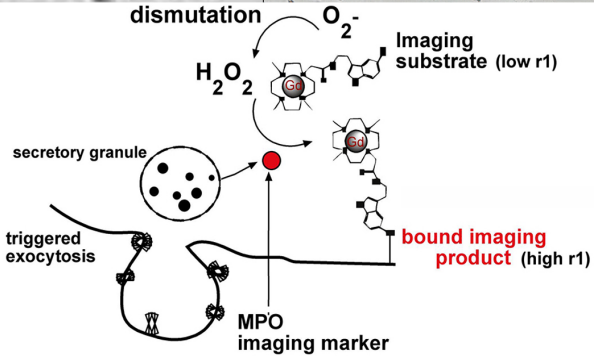












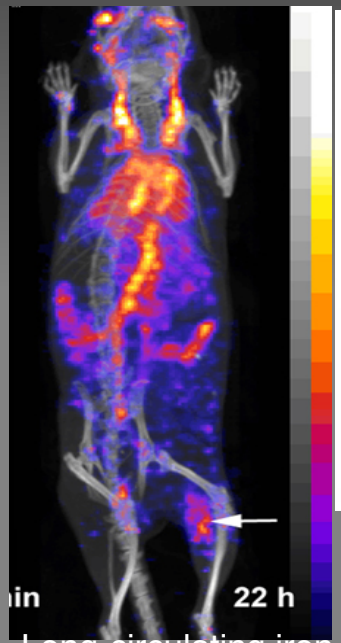
MJ Gounis et al. Stroke. 2014;45:1474-1477; AJNR 2015, 36:146 –52

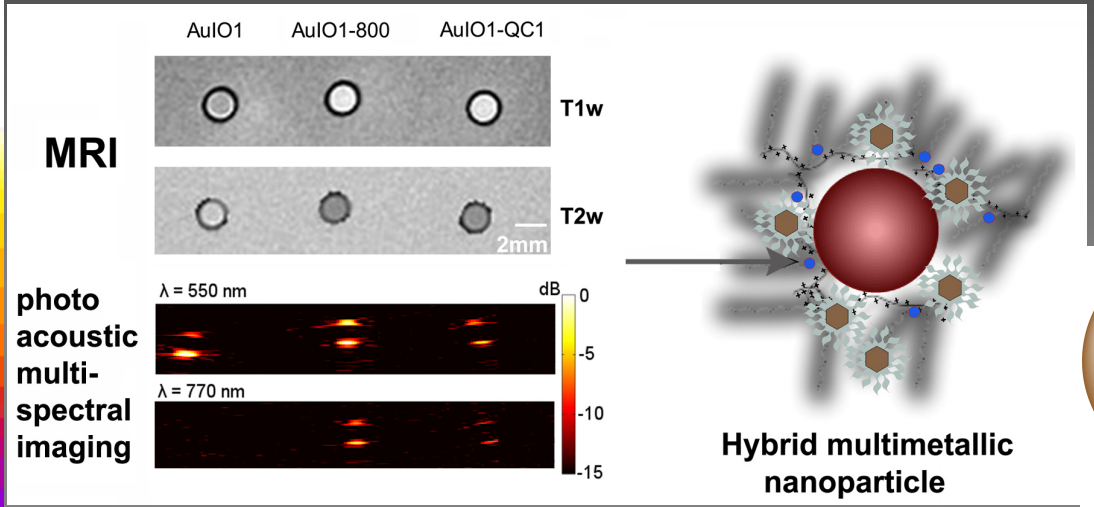
PI: A. Bogdanov

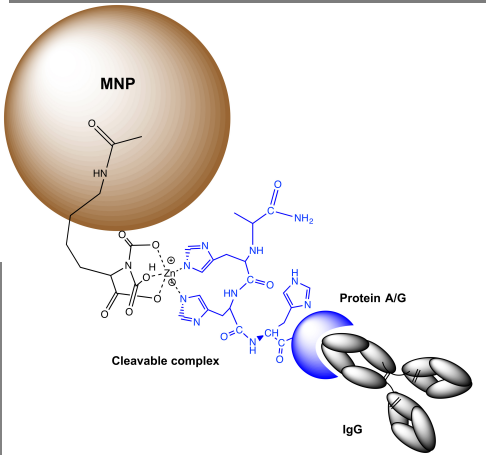
R01EB000858-12

MR signal amplification for receptor imaging

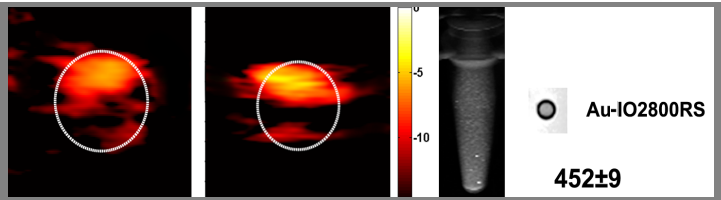
Goal: investigate imaging probes for signal enhancement in vivo







Long-circulating iron-oxide/gold nanoparticles for multispectral photoacoustic/MR imaging



PAI 550 770 nm

Cancer Res. 2011 71: 2230-2239; Mol Imag Biol. 2013 15:675-84, Bioconj Chem., 2015, 26:39–50. Bioconj Chem, 2016, 27: 383-90